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ABSTRACT

This descriptive study was conducted to evaluate the relative emphasis secondary school teachers place on the science teaching goals of the 1960s which focused on processes and techniques designed to produce scientists, as compared to the goals of the 1980s which give priority to the relationship of science and technology to society. An eight-item bipolar scale which reflected the major goals of science for the 1960s and 1980s was developed as the study instrument. The sample population consisted of all middle and secondary school science teachers in the state of Delaware (N=307); analysis was based on the 113 questionnaires that were returned with complete information. The results indicated that the majority of respondents believed that science instruction should emphasize both sets of goals. When only those responses indicating a preferred goals orientation were considered, teachers facored the 1980s goals. Also teachers favoring 1980s goals felt stronger in their conviction than teachers preferring the 1960s goals. Implications and limitations of the study are discussed and a copy of the survey is appended. (RT)

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Teachers' Conceptions of the Contemporary Goals of Science Education

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Teachers' Conceptions of the Contemporary Goals of Science Education

Much has been written recently urging science educators to reconsider the goals that come about as a result of the 1960's curricular reform movement. For example, many leaders in the field have agreed that knowledge of the societal implications of science and technology are of paramount importance. Efforts to communicate contemporary goals are ongoing and the effect of these efforts needs to be determined. To this end, this study was initiated to examine what middle and high school science teachers believe should be the goals of science education for the remainder of the 1980's. Participants were given an 8 item questionnaire and asked to choose a position on a bipolar scale that had, at one extreme, a statement reflecting a 1960's goal and at the other extreme a statement corresponding to modern science education goals. Additional information such as year of degree, grade level taught and attendance at workshops was compiled. The results of this survey indicated that the majority of respondents believe that science instruction should equally emphasize both the goals of the 1960's and the 1980's. A subsequent analysis demonstrated that when only those responses indicating a preferred goals orientation were considered, teachers expressed predilection towards 1980's goals. Furthermore, those teachers who favor 1980's goals felt stronger in their conviction than teachers expressing a 1960's goals preference. A discriminant analysis was

employed to study whether or not differences in definitive 1960's or 1980's views were associated with one or more items on the personal data questionnaire. It was found that a combination of teaching middle school grades (6-8), attending more in-service workshops is moderately associated with an eighties orientation to the goals of science education. The results of the study lead the authors to recommend that a concerted effort be made by professional organizations to convey the importance of contemporary goals to teachers at the high school level. Additionally an effort should be made to disseminate these goals through local seminars and workshops.

Teachers' Conceptions of the Contemporary Goals of Science Education

Purpose of Study

By now, we are much aware of the impact of public opinion on education reform. At no time was this more evident than the rush to modify science curricula in the wake of the Sputnik launch of 1957. The goals of science education in the 1960's were characterized by an emphasis on processes and techniques designed to produce scientists (Anderson, 1983). The "new" science curricula spawned hands-on activities and process skills that emulated the scientific endeavor. There was little concern for the interrelationship of science, technology and society. With the advent of the Project Synthesis document (Harms and Yager, 1978) and the subsequent realization that a true crisis existed in science education, further reform seemed necessary. Science educators have advocated new goals that address todays need for a scientifically and technologically literate populace (Hofstein and Yager, 1982). Additionally the National Science Teachers Association has issued a position statement on the role of science, technology and society for the 1980's (NSTA, 1983).

Throughout the discipline a major redirection of goals is taking place. In the 1960's, goals were established and communicated to the classroom teacher principally by way of workshops, in-service programs and journal articles. In the 1980's however, federal monetary support has substantially

diminished and few workshops and in-service programs are currently being offered. The dissemination of goals is relegated primarily to the print media and meetings of professional organizations concerned with science education. With this in mind, it seems appropriate not only to assess the effectiveness of these efforts in communicating the contemporary goals of science education but also to assess the conviction with which these goals are held by the classroom teacher.

This descriptive study was conducted to address that issue. A contemporary goals survey was designed to evaluate the relative emphasis that middle and high school teachers in the state of Delaware place on the science teaching goals of the 1960's as compared to the goals of the 1980's, particularly with respect to the relationship of science and technology to society.

Theoretical Basis (Rationale)

A review of the literature available in ERIC by the authors prior to the initiation of this research revealed only one article related to assessing teachers perceptions of the goals of science education of the 1980's (Berkheimer, 1984). The population in this study was science education faculty and graduate students. It seemed a logical outgrowth to extend this research to middle and high school teachers to assess their perceptions of the contemporary goals.

Procedure

Instrumentation

An eight item bipolar scale which reflected the major goals of science education for the 1960's and 1980's was derived from NSTA position statements and modeled from Kyle (1984). At one end of the continuum for each question was a statement reflecting a predominately 1960's orientation while the opposite end was one representing a 1980's emphasis. Teachers were asked to choose one of seven spaces on the continuum for each question that best describes the emphasis that they felt should be placed on the goals of science education for the last half of the 1980's. Content validity was established by sending the questionnaire to six prominant teachers and researchers in science education who hold (or have recently held) elected positions in NSTA or NARST, and have contributed to science curriculum goals. Those experts were asked to evaluate the relevancy of the items with respect to the 1960's and 1980's goals of science education. Their suggestions were compiled and a final revised questionnaire constructed (see Table I).

INSERT TABLE I ABOUT HERE

The order of items beginning with a particular orientation were randomly varied. Included on the questionnaire were items which elicited additional information relevant to

variables in this study (e.g.: year of undergraduate/graduate completion, number of state, national, in-service workshops attended in last four years). Test-retest reliability was determined to be .75 (Spearman Rank, n = 26) using public school teachers.

Sample

The sample consisted of all middle (6-8) and secondary (9-12) school science teachers in the state of Delaware. After an initial mailing of 307 questionnaires, and follow-up letter, the return rate was 47%. The total number of those who provided complete information on which subsequent data analyses was based was equal to 113 subjects.

Results

Part I

To provide an overview of the results of this study a descriptive analysis of the questionnaire was undertaken. Response frequencies and percentages were tabulated for each statement category (see Table II). Observation of total frequencies for the questionnaire reveals that the "equal emphasis" response was chosen the highest percentage of the time (33.9%). Respondent's most frequently indicated a preference that contemporary science instruction should provide equally for the goals of the 1960's and the 1980's.

INSERT TABLE II ABOUT HERE

The second most frequent response choice was that indicating a strong 1980's orientation (16.1%). A strong 1960's orientation was least favored (7.1%). The exceptions to this pattern occurred in statements 4 and 6 and upon closer examination, these statements are revealing. For example, the 1980's position is similar to the 1960's position except that the former includes the notion of affective, ethical and aesthetic experiences. In statement 8, however, science teachers responded favorably to the inclusion of ethical and moral considerations as possible goals. It must be the case that affective and/or aesthetic components are the most resistant to acceptance since participants summarily rejected this orientation in statement 4. Question 6 compares the issue of addressing future societal problems versus present understanding of the world. It was found that 15% indicated strong support for the latter while only 5.3% indicated strong support for a discipline concerned with the resolution of future societal problems.

The orientation to a 1960's position in statements 4 and 6 becomes even more obvious if we collapse the categories on either side of the "equal emphasis" position (see Table III). The combined frequencies, indicating a 1960's position, demonstrate that a resounding 62% of respondents rejected the inclusion of affective and aesthetic goals. Question 6 also becomes more informative, with 43.3% indicating that science

teaching goals should stress present understanding of the world rather than the resolution of future societal problems (14.2%). It should be noted that this percentage is greater than that indicating that both positions should at least have equal emphasis. Including anomalous statements 4 and 6, the total percentages in Table III indicate a rather even distribution between 1960's and 1980's orientations, with the 1980's position being slightly favored. If, however, statements 4 and 6 are removed from consideration, a decidedly 1980's position is taken (see last row of Table III).

INSERT TABLE III ABOUT HERE

It was also of interest to consider a "strength of conviction" index of those not responding with the equal emphasis choice. This would indicate how strongly those favoring a particular goal statement felt about their selection. To provide this index, numbers were assigned to the category positions and a weighted mean was calculated for each of the collapsed categories in each statement. The deviation of this score from the equal emphasis position revealed the relative strength of preference for either 1960's or 1980's goals (see Table IV). The mean 1980's deviation (2.3) was shown to be greater than the mean 1960's deviation (1.9). This was true for each statement in the survey except item 4. Although it was shown previously that the majority felt

that aesthetic issues should not be included in a science class, those participants that expressed disagreement with this view felt equally as strong that these issues should be included as goal statements. It is also worthy to note that while the majority viewed a 1960's approach to statement 6 to be most favorable, those indicating a 1980's preference felt just as strongly about their selection.

INSERT TABLE IV ABOUT HERE

Part II

The sample was then divided into two groups, those who completed their undergraduate degree on or before 1969 and those who finished on or after 1970, on the premise that the different pedagogical emphasis of those two decades might have bearing on teachers present conceptions of science education goals. Group means for each statement were plotted and a profile analysis using the one tailed probability sign test was performed. This test revealed and indicated that no significant differences ($p \leq .14$) was exhibited between groups. Although one may have expected that those teachers who completed their B.S. on or after 1970 to have consistently greater means (1980's orientation) than those before 1970, this analysis indicated that neither group displayed a predominant preference for either orientation (60's vs. 80's). When the sample was divided into two groups based

upon the year that they completed their graduate master's degree ($\leq$1969 vs. $\geq$ 1970), the same results were found. (It should be emphasized that some of those in the latter group division are the same subjects as in the former group division.)

Part III

Inasmuch as a different pattern was revealed in part I when non-commital (equal emphasis) responses were eliminated from the analyses, discriminant analysis was employed to study whether or not differences in definitive 1960's or 1980's views were associated with year of undergraduate degree completion, grade level taught, attendance in state, national and in-service workshops. The stepwise method for selection of variables was Rao's V, which maximizes separation of group centroids (in this case - 1960's vs. 1980's orientations). It was found that grade level taught /middle (6-8) vs. secondary (9-12)/ and attendance at in-service workshops, formed one significant canonical discriminant function (X^2 = 13.13, df = 4, $p \leq .01$). Each of these variables significantly increased Rao's V ($p \leq .01$ and .05 respectively) which represents an increase in overall separation of group centroids (1960's vs. 1980's orientations). Furthermore, these variables correctly predicted 72% of those teachers composing a 1960's orientation and 67% of those with a 1980's one (n = 99). Interestingly, the

canonical discriminant function coefficients (.59 and .46 respectively) would suggest that they are moderately related to contemporary goal orientation. Specifically, a combination of teaching middle school grades (6-8) and attending more in-service workshops is moderately associated with an eighties orientation to the goals of science education.

Implications and Limitations

Interpretation of the descriptive data suggests that the majority of science teachers in Delaware believe, with two noteworthy exceptions, that science education goals commonly associated with a 1980's perspective should be emphasized to some degree in a contemporary science class. The two exceptions are illustrated by the response frequencies attributed to statements 4 and 6 of the contemporary goals survey. Respondents, in the former statement indicated a rejection of affective goals and aesthetic experiences in the science classroom. In the latter statement these same respondents indicated that the resolution of future societal problems is a less appropriate goal than understanding the world as it is today.

It would seem at first glance that efforts by national organizations and prominant educators have been successful in sensitizing science teachers to such modern day goals as the interaction of Science, Technology, and Society. It is disconcerting, however, that science teachers hold affective

and aesthetic experiences in such low regard. Surely a true understanding of STS issues lies in the appreciation of the environment that we seek to preserve by addressing these issues. Perhaps a more concerted effort might be made to address affective goals at the national level.

If given a choice there are indications that science teachers would prefer to emphasize science as a vehicle for understanding the modern world rather than as a means of resolving future societal problems. While the preferred position is debatable, individuals or organizations may find this information useful when considering prevailing goals orientation. Furthermore, those science teachers professing a 1980's orientation demonstrated a stronger conviction for their position than those with a predominately 1960's disposition. Apparently contemporary goals are important to those who embrace them. Goal setting agencies should not abandon their sense of urgency.

It is of interest to note that middle school teachers tended to have an 1980's orientation while high school teachers a 1960's orientation (as indicated in part III of the results). Perhaps high school teachers are more "content conscious" with little time to treat the subject matter as a unified discipline. This would suggest that a concerted effort by professional organizations such as NSTA, NARST or AETS is needed to help convey contemporary goals to the

secondary school teacher. According to the results of the present study, an effort made to disseminate the goals on the local level (particularly within the context of in-service workshops) would appear to have a facilitative influence on teachers perceptions of contemporary goals.

Since this study was conducted within the state of Delaware, the question may arise as to whether the findings are generalizable to public school teachers from other states as well. Subsequently, while our claims are based upon the present sample, we are at a loss to think of any compelling arguments as to why teachers in Delaware would not be representative of teachers in any other state; for this sample consisted of teachers ranging from city to rural school districts.

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TABLE I
CONTEMPORARY GOALS SURVEY

Directions: Check one space on the continuum that you believe best describes the emphasis that should be placed on the goals of science education for the last half of the 1980's.

1.	Science education courses should be primarily designed to produce more scientists and engineers to solve scientific problems.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	Science education courses should primarily be designed to familiarize all students with the interaction of science, technology and society.
2.	The most important knowledge that a science student should have are those facts, concepts and principles that represent the structure of the discipline taught.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	The most important knowledge that a science student should have are those facts, concepts and principles that would be relevant to the solution of social and technological problems.
3.	The major focus of science education should be geared to preparing future citizens.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	The major focus of science education should be geared to the training of future scientists.
4.	In addition to knowledge acquisition, science education should focus upon student experiences with process skills such as inferring, identifying variables, etc.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	In addition to knowledge acquisition and process skills, science education should focus upon the affective domain, including ethical and aesthetic experiences.
5.	Science education should emphasize decision-making skills that demand divergent thought processes that seek to examine interrelationships between and among environmental systems.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	Science education should emphasize inquiry skills that demand those logical, convergent thought processes that are associated with the "scientific method" used in investigation.
6.	Science education should be construed as a discipline that is concerned with the resolution of future societal problems.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	Science education should be construed as a discipline that contributes greatly to our present understanding of the world in which we live.
7.	Contemporary goals of science education should differ within each discipline (biology, chemistry, etc.). That is they should be intrinsically defined by the nature of the subject area.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	Contemporary goals of science education should be interdisciplinary in nature and defined by the interaction between science, technology and society.
8.	Science should be presented as a value laden subject that has both moral and ethical dimensions.	Strong	Moderate	Slight	Equal Emphasis	Slight	Moderate	Strong	Science should be presented as value-free, without moral or ethical issues, in and of itself.

TABLE IV
STRENGTH OF CONVICTION FOR PREFERRED GOAL ORIENTATION

Statement Number	1960's Weighted Mean	1960's Deviation of Weighted Mean From Equal Emphasis	Equal Emphasis	1980's Deviation of Weighted Mean From Equal Emphasis	1980's Weighted Mean
1	2.3	1.7	4	2.4	6.4
2	2.1	1.9	4	2.3	6.3
3	2.4	1.6	4	2.5	6.5
4	1.9	2.1	4	2.1	6.1
5	2.2	1.8	4	2.2	6.2
6	1.8	2.2	4	2.3	6.3
7	2.1	1.8	4	2.2	6.2
8	2.2	1.8	4	2.1	6.1
Average Mean Deviation		1.9		2.3	

TABLE II
RESPONSE FREQUENCIES AND PERCENTAGES (IN PARENTHESES)
FOR THE CONTEMPORARY GOALS SURVEY

Statement Number	1960's Goal Orientation			Equal Emphasis	1980's Goal Orientation		
	Strong	Moderate	Slight		Slight	Moderate	Strong
1	1 (0.9)	12 (10.0)	6 (5.3)	40 (35.5)	9 (8.0)	15 (13.3)	30 (26.5)
2	5 (4.4)	17 (15.0)	8 (7.1)	36 (31.9)	7 (6.2)	18 (15.9)	22 (19.5)
3	1 (0.9)	8 (7.1)	8 (7.1)	42 (37.2)	12 (10.6)	17 (15.0)	25 (22.1)
4	22 (19.5)	32 (28.3)	16 (14.2)	35 (31.0)	3 (2.7)	1 (0.9)	4 (3.5)
5	7 (6.2)	12 (10.6)	12 (10.6)	60 (53.1)	6 (5.3)	6 (5.3)	10 (8.8)
6	17 (15.0)	26 (23.0)	6 (5.3)	48 (42.5)	1 (0.9)	9 (8.0)	6 (5.3)
7	6 (5.3)	14 (12.4)	10 (8.8)	22 (19.5)	12 (10.6)	22 (19.5)	27 (23.9)
8	5 (4.4)	15 (13.3)	12 (10.6)	23 (20.4)	14 (12.4)	22 (19.5)	22 (19.5)
Total Questionnaire	64 (7.1)	136 (15.0)	78 (8.6)	306 (33.9)	64 (7.1)	110 (12.2)	146 (16.1)

TABLE III
COMBINED RESPONSE FREQUENCIES AND PERCENTAGES (IN PARENTHESES)
FOR THE CONTEMPORARY GOALS SURVEY

Statement Number	1960's Goal Orientation	Equal Emphasis	1980's Goal Orientation
1	19 (16.8)	40 (35.4)	54 (47.8)
2	30 (26.5)	36 (31.9)	47 (41.6)
3	17 (15.1)	42 (37.2)	54 (47.7)
4	70 (62.0)	35 (31.0)	8 (7.1)
5	31 (27.4)	60 (53.1)	22 (19.4)
6	49 (43.3)	48 (42.5)	16 (14.2)
7	30 (26.5)	22 (19.5)	61 (54.0)
8	32 (28.3)	23 (20.4)	58 (51.4)
Total Questionnaire	278 (30.7)	306 (33.9)	320 (35.4)
Totals with Statement Numbers 4 and 6 Omitted	159 (23.4)	223 (32.9)	296 (44.0)